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THE SEPARATION OF RAILROAD OPERATING EXPENSES BETWEEN FREIGHT AND PASSENGER SERVICES

SUMMARY

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I

THE increasing importance attached by the Interstate Commerce Commission to cost of service as a prime factor in rate cases is seen in many recent decisions.¹ The evidence and the briefs presented both by the railroads and by the protestants now give special prominence to expense apportionments; and certain firms of public accountants have specialized as experts in railroad rate cases.

¹ Among them the following are of special interest: Five Per Cent case, 31 I. C. C. 392; Anthracite Coal case, 35 I. C. C. 220; 1915 Western Rate Advance case, 35 I. C. C. 497; Western Passenger Fares case, 37 I. C. C. 1; Lake Erie Ports Iron Ore case, 41 I. C. C. 181; and New England Milk case, 40 I. C. C. 699.

One of the first important cases in which cost statistics played a very important part was that decided by the Wisconsin Railroad Commission on February 16, 1907. (*Buell v. C., M. & St. P. Ry. Co.*, 1 Wis. R. R. C. Rep., p. 324.) The railroad company, in support of its proposed advances in passenger fares, presented elaborate statistics purporting to show that the passenger service, taken by itself and charged with its fair share of operating expenses, taxes, and charges, failed to earn a reasonable return on the investment. The computations required a separation of all of the accounts, not only between freight and passenger service, but also between Wisconsin and the other states served by the Chicago, Milwaukee and St. Paul Railway. In criticizing the methods employed by the railroad, the Wisconsin Commission laid down certain principles applying to the apportionment of income and outgo, and the decision may be regarded as a bench mark in railroad cost statistics in rate cases. In the opinion of the Commission:

The most essential element in the fixing of a reasonable rate is the cost of service to the carrier. There are very many other facts which also should be taken into account, but none of them seems to be as vital or as necessary to a just and fair conclusion as the cost. Without some facts which indicate the approximate cost per unit of service, or per unit of transportation, it would seem to be practically impossible to say at what figures the rates should be fixed in order to yield operating expenses and a fair rate of interest on the investment.

The purpose of the present article is to discuss the various methods used by the railroads and public accountants for separating operating expenses between the freight and passenger services, and to suggest a solution for one of the most difficult of the problems. It is not the purpose of the article to touch upon the value

of cost of service as an element in rate-making.¹ Regardless of the limited application of such evidence in determining the reasonableness of rates affected also by competition of carriers, competition of markets, competition of commodities, and other factors which may have the prevailing influence, the Commissions and the Courts have decided in a long list of cases that information as to the cost of service is essential, particularly in general advances in rates. In the Western Passenger Fares case (37 I. C. C. 497), for example, the decision of the Commission apparently hinged upon the figures showing the relative remunerativeness of the passenger service compared with that of the freight service.

The railroads, therefore, are taking more interest in the problems connected with the separation of expenses. Instead of magnifying the difficulties inherent in the attempt to separate joint costs, and ridiculing the bases which have been suggested, the railroads are now making an earnest effort to devise methods to produce results which will be of value not only in rate cases but will also afford the railroads themselves valuable information of a "cost accounting" nature which heretofore many of them have lacked. Unfortu-

¹ Nor is any consideration given here to the propriety of regarding the results obtained by allocation and apportionment of expenses as "cost" figures. See article by Allen S. Olmsted, 2d, "Do 'Cost of Transportation' Exhibits in Railroad Rate Cases show Cost?" *Annals of the American Academy of Political and Social Science*, Philadelphia, January, 1916, Publication no. 973. Olmsted believes that the word "cost" in such cases is a misnomer. "Such computations consist of two processes. One is an *allocation* to a particular traffic of costs attributable solely to it; the other is an *apportionment* between the particular traffic and other traffic of costs jointly caused by both kinds of traffic. . . . Allocation is the assignment of facts; apportionment is the determination of policy. The former concerns itself with what is; the latter with what should be. One process consists of untwisting the intertwined but separate and distinct strands of a particular causation; the other of splitting the homogeneous fibres of a single cost jointly caused. Allocation aims to find what each service *costs*; apportionment aims to determine what each service *ought to pay*. . . . Combining the two figures seems like adding quarts to feet. The desirable course would seem to be to resolve the total 'cost' into its constituent elements, one marked 'Matter of Fact — Allocated Cost of Service' and the other labeled 'Matter of Opinion — Mathematical Photograph of Witness's Sense of Justice.'"

nately, however, little progress has been made in standardizing the accounting practice. Both as between the railroads themselves and as between the railroads and public accountants (as well as between the public accountants themselves) there is much confusion and conflict.

II

During the first seven years of the Interstate Commerce Commission's jurisdiction over the accounts and statistics of interstate carriers (from July 1, 1887, to June 30, 1894) the Commission required the railroads to report their operating expenses separately as between the freight and passenger services. Definite rules, however, were not promulgated, and much latitude was allowed the railroad accountants. The early reports of the Commission contain tabulations which purport to show not only the average revenue per passenger mile and per ton mile, but, as well, the operating expenses applicable to each unit of service. On their face, the figures gave an indication of the relative remunerativeness of each class of service, but as the experience of seven years developed serious difficulties in practice, and as the results were widely discredited both by the railroads and public regulating authorities,¹ the Interstate Commerce Commission withdrew the requirement. The *First Revised Issue of the Classification of Operating Expenses* (effective July 1, 1894) omitted any reference to the subject.

¹ "The test of actual practice fails to satisfy us that these rules are of any utility either to the companies, the states or the nation. Indeed, if not substantially correct they could not be expected to be useful and may prove positively vicious. We know what results have been reached by the application of these rules for division which are grossly erroneous not to say preposterous." From Report of Committee on Uniformity of Accounts, Proceedings of the Fourth (1892) Annual Convention of the National Association of Railway Commissions, p. 23.

Now, after a lapse of twenty-one years, during which the authority over railroad accounting has been made absolute, the Interstate Commerce Commission has renewed the requirement. Effective July 1, 1915, carriers having annual operating revenues of \$1,000,000 or more, are instructed to report a division of operating expenses in accordance with the Commission's *Rules Governing the Separation of Operating Expenses between Freight Service and Passenger Service on Large Steam Railways*.

Briefly, the Commission, while avoiding extreme particularity in its instructions, lays down the general principles that:

(1) Such expenditures as may be definitely and accurately allocated should be reported separately.

(2) Such expenditures as may not be definitely and accurately allocated, but which are susceptible of apportionment on some basis which will approximately represent the facts, should be pro-rated.

(3) Such expenditures as those which defy any accurate or even any approximate allocation or apportionment should be reported as "undivided," the Commission to determine later, or as needed in special cases, how the undivided items should be split between the two classes of service.

The three divisions, then, are:

(a) Direct charges.

(b) Indirect charges susceptible of approximate separation.

(c) Overhead or other joint costs which are very difficult to separate.

In the first group are the wages of the locomotive and train crews, the cost of locomotive fuel, the maintenance of motive power and other rolling stock, the charges to freight claims and baggage claims, and other

minor items of expense which may be kept entirely distinct by classes of service.

In the second group are such accounts as station service, which may be directly allocated in a large part, the remainder to be divided in proportion to "man hours" in each class of service; yard service, directly allocable in part, the remainder to be separated in proportion to "locomotive hours" in each class of service.

In the third group are most of the items under maintenance of way and structures, such as roadway maintenance, the renewals of rails, ties and ballast, and the maintenance of work equipment. It includes as well all items classified as general expenses.

Throughout the maintenance of way group, which presents the most difficult problems in apportionment, the Commission requires that under each account such expenses as may be directly traced or recorded should be charged either to the freight or to the passenger service, the remainder to be regarded as joint expenses and reported as undivided. Superintendence, for example, is to be reported as undivided. With respect to maintenance of station buildings, the rules require that carriers keep a record of maintenance costs of freight stations (to be charged to freight) and of passenger stations (to be charged to passenger) and that the remainder should be pro-rated in the same proportion as the direct charges to that account. All roadway and track expenses, with the exception of yard track maintenance (which is to be recorded separately and divided between freight and passenger in proportion to switch locomotive miles in each class of service) and maintenance of roadway buildings, are to be reported as undivided. Maintenance of water and fuel stations is to be divided on the basis of the freight and passenger

proportions of fuel costs. Maintenance of shops and engine houses is to be divided in the proportion which the freight and passenger services assume in the total charges to the maintenance of equipment group of expenses. The cost of maintaining grain elevators, storage warehouses, and the like, is to be assigned directly or apportioned according to the facts in individual instances. The maintenance cost of telegraph and telephone lines, and of signals and interlockers, is to be divided on the basis of transportation train miles. Power plant maintenance is to be assigned according to facts in individual instances. Maintenance cost of paving, roadway machines, etc., and the charges to injuries to persons, insurance, stationery and printing, and other maintenance of way expenses are to be reported as undivided, unless a determination of facts in individual instances makes definite allocation possible. The cost of maintaining joint tracks and other joint facilities should, as far as practicable, be treated individually according to the use made of them by the reporting carrier, regardless of the use made of them by other carriers.

Under maintenance of equipment expenses one item only (work equipment — repairs, depreciation and retirements) is to be reported as undivided. The maintenance of work equipment is to be regarded as an undivided expense and should be treated in the same manner as roadway and track costs. With respect to the maintenance and replacement of locomotives and cars (other than work equipment) the railroads are required to keep their accounts in such form that the actual cost of repairing and replacing of freight locomotives and cars shall be charged to the freight service, and that the similar costs for passenger locomotives and cars shall be charged to the passenger service. In the

case of locomotives used in both classes of service, the expense is to be pro-rated on the basis of locomotive miles in each class of service, altho permission is given to use "some arbitrary deemed by the carrier to be applicable, as, for example, by making one and a half passenger locomotive miles equivalent to one freight locomotive mile." The cost of maintaining locomotives used in mixed train service is to be apportioned on the basis of car miles in mixed trains (unless the carrier is able to make a more nearly accurate estimate), and the maintenance cost of switch locomotives is to be divided according to the freight and passenger switching locomotive miles. For the latter account the railroads are permitted to take all yards together annually. This is essentially a "locomotive hour" basis, since switching locomotive mileage is computed on the arbitrary basis of six miles per hour, according to the rules of the Commission pertaining to the compilation of locomotive, train and car mileage.

For the charges on account of depreciation and retirements of locomotives and cars the rules require an assignment "direct as far as practicable," and an apportionment of the unassigned remainder "according to the mileage made in each class of service by the individual locomotives (or cars) or by classes of locomotives (or cars)." In the case of locomotives alone "if this method is not practicable, then the division should be made according to the aggregate freight locomotive and passenger locomotive ton mileage of the locomotives affected for the year, or upon some other basis deemed by the carrier to be more nearly accurate."

Charges to superintendence (maintenance of equipment), shop machinery, power plants, floating equipment, miscellaneous equipment, injuries to persons, insurance, stationery and printing, and other main-

tenance of equipment expenses, are to be apportioned on the same basis as the freight and passenger proportions of repairs of locomotives and cars. The same basis is to apply to maintaining joint equipment at terminals "unless a knowledge of local conditions enables a carrier to make a more nearly accurate estimate. Each terminal should, as far as practicable, be treated individually."

The entire group of traffic expenses is to be assigned directly. This is usually practicable, in as much as the freight traffic department and the passenger traffic department are ordinarily distinct and separate below the executive offices. Common traffic expenses are to be apportioned on the basis of the directly assigned expenses in this general account.

In the group of transportation expenses no items are to be reported as undivided. The cost of dispatching trains is to be apportioned according to transportation train miles. The cost of station employees and station supplies and expenses is to be charged according to direct analysis, the common expenses to be apportioned as in the case of superintendence (to be mentioned later). Charges to weighing, inspection and demurrage bureaus, and to coal and ore wharves operation, are to be assigned directly. The yard group of expenses is to be assigned directly as far as practicable, the unassigned remainder to be apportioned in accordance with the freight and passenger yard switching locomotive miles of the year, each yard to be treated individually, if practicable, but at least excluding the mileage of those yards which have been treated as wholly freight or wholly passenger. In the cost of operating joint yards and terminals, each yard or terminal is to be treated individually, and a separation made according to local conditions.

The wages of train enginemen, motormen and train crews, the cost of fuel, water and other locomotive supplies, and the cost of train supplies, are to be assigned directly as far as practicable, common expenses to be divided on the basis of the direct assignments in each account. The charges to road engine-house expense are to be divided according to the number of engines handled for each class of service, an arbitrary to be used, if deemed proper, to give freight locomotives a greater weight than passenger locomotives. Operation of sleeping cars, express service and baggage claims are to be charged direct to passenger. The cost of settling freight claims is to be charged direct to freight. Charges to signal operation and crossing protection are to be apportioned on a transportation train mile basis. The expense of clearing wrecks is to be assigned directly, as far as practicable, according to the service in which the accident occurred and not according to the responsibility for the accident, the unassigned remainder to be divided (like superintendence) on the basis of the entire assignable items in the transportation expenses group. The charges to damage to property, damage to live stock on right of way, and injuries to persons, are to be treated the same as clearing wrecks. The remaining transportation accounts — namely, superintendence, train power purchased and produced, operating floating equipment, stationery and printing, insurance, and other transportation expenses — are to be divided according to the freight and passenger proportions of the aggregate of the assignable items in the transportation group. The cost of operating joint tracks and facilities is to be similarly treated “unless a knowledge of local conditions enables the carrier to make a more nearly accurate estimate.”

Transportation expenses of water lines, miscellaneous operations, and general expenses, are to be assigned directly as far as practicable, the remainders to be reported as undivided "unless a knowledge of local conditions makes possible a more nearly accurate estimate."

Carriers are required to indicate the total amount of credit which should be given to the freight service for work (such as carrying company fuel and other company supplies) performed for the passenger service, and *vice versa*.

III

In the hearings on this subject, following the publication by the Commission of the tentative rules for separating expenses, there was an apparent acceptance of the principle that such separation is necessary, and no serious differences in opinion developed as to the methods proposed, except with reference to those applying to maintenance of way and structures expenses which are common both to freight and passenger services. The representatives of state commissions advocated the use of the "gross ton mile" basis, while the representatives of some of the railroads favored "engine ton miles." By gross ton miles is meant the weight of the train behind the locomotive tender — cars and contents — times the miles made by the train. By engine ton miles is meant the tons of locomotive — ready for service (excluding the tender) — times the miles made by the locomotive. In both cases the ton is taken as 2,000 pounds.

In the opinion of the Commission, as expressed in the foreword to the rules as finally promulgated, the facts and arguments presented did not at that time warrant the final approval of the Commission of any one of the

three bases suggested, namely, gross ton miles, engine ton miles, or direct charges, as the divisor for joint maintenance of way expenses. Carriers are required, until further notice, to compute engine ton mile data, and the relative merits of the three bases, or modifications thereof, are to be further considered by the Commission with the aid of the statistics thus made available.

The absence of definite instructions to govern in the controversial features connected with the separation of the maintenance of way expenses is unfortunate. The Commission, evidently, is unwilling as yet to commit itself to hard and fast rules. In recent cases (particularly the Western Passenger Fares case to be referred to later) it has taken pains to make clear that where apportionments of expenses have been accepted, the Commission has not thereby given approval to any particular formula for maintenance of way expenses. Apparently, further time is desired to consider conflicting evidence as to the fairness and propriety of the alternative bases, and to observe the effect of the 1915 rules pertaining to the subject. In the meantime, the railroads hesitate to commit themselves to any one formula, fearing that it may not have a place in the next edition of the Commission's rules. The separation of the maintenance expenses, and necessarily of the total operating expenses, is but partially accomplished, and the tendency on the part of the railroads will probably be to report a large part of expenses as "undivided."

As has already been stated, it is in connection with the separation of maintenance of way expenses that there exists the greatest diversity and divergence in opinion and practice. Such items as roadway maintenance, tie renewals, and repairs to bridges, trestles, and culverts, form the most baffling of apportionment problems.

The cost of maintaining the roadbed and track structures is influenced by many factors. These factors may be classified into at least three groups:

(1) Natural deterioration or disintegration; caused by the elements.

(2) Wear and tear; caused by locomotive and car use.

(3) Standard of maintenance; determined by the policy of the management.

The effect of the elements is seen in the decay of ties, the wasting or fouling of the ballast by rain, high water, and winds, the clogging of the ditches, the erosion of slopes and embankments, the corrosion of rails, rail fastenings, tie plates, bridge members, and other steel structures, and the deterioration of buildings and other wooden structures. This deterioration or waste is entirely independent of and bears practically no relation to the use to which the track and structures are put.¹

As to what proportion of the cost of repairs and renewals is due to the action of the elements and what proportion is due to the wear and tear of train traffic, there are no exact data, and the opinions of engineers and accountants differ widely. In the Buell case ² the Chicago, Milwaukee, and St. Paul Railway set the percentage due to the elements at 25 per cent. To this the Wisconsin Commission properly took exception, as the weight of opinion is decidedly against such a low percentage. Woodlock, in his monograph on *Ton Mile Cost* estimates that 90 per cent of the cost of maintaining the roadbed is due to natural deterioration. Other authorities quoted by the Wisconsin Commission

¹ The standard of maintenance will naturally be higher on the road with heavy traffic, and the point at which deterioration will cause a removal and renewal of parts will be reached sooner than on the road with light traffic.

² 1 Wis. R. R. Com. 324.

support percentages similarly high. For tie renewals, Woodlock charges 67 per cent to decay. For bridge maintenance he sets the percentage due to the elements at 90 per cent. The Wisconsin Commission decided that in the case of ties between two-thirds and three-quarters would be fair, and as to bridge maintenance costs (consisting largely of charges for painting) the percentage given by Woodlock was approved.

As a practical matter little is to be gained by attempting to separate maintenance costs between those due to the elements and those due to traffic, unless, as was true in the Buell case, different bases were used in separating the two component parts of maintenance expenses between the freight and passenger services. In some computations the cost due to wear and tear was divided according to use, as expressed by locomotive or train miles or combinations of the two, and the cost due to elements was divided on the basis of road or track miles, or on gross revenues. In the Buell case the Wisconsin Commission adopted such a method because it was considered unfair to the state of Wisconsin, in which the traffic density of the railroad was greater than in other states, to charge that state with its train mile proportion of all maintenance of way expenses when only a part, and a relatively small part, was due to the wear and tear of traffic. The Commission, therefore, decided that the wear and tear proportion only should be apportioned on train miles and that the remainder should be apportioned on road miles. This method, of course, had the effect of reducing the charge to Wisconsin.

The wear and tear of the roadbed, track structure, and bridges, trestles and culverts are caused by the action of locomotive and car wheels. The degree of wear and tear, and of stress or shock, varies in some degree with

the wheel load, the diameter of the wheel, and the speed. It is influenced also by the design of the locomotive and cars in such particulars as length of rigid frame, counter-balances in driving wheels, quality of springs and riding characteristics of trucks. The wear and tear and shock are felt first and in greatest degree by the rail and rail fastenings; next by the bridges and trestles; and least by the ballast and roadbed.

The policy of a railroad company with respect to the standard of roadway maintenance is influenced by the financial ability of the company and by the character of the traffic. A prosperous road with a dense passenger traffic usually adopts a higher standard of maintenance, and expends more money on that account, than the poorer road with little passenger service. So far as safety in operation is concerned, there may be little difference between the two roads. Looking at the subject from the viewpoint of cost accounting, however, we are perplexed in our efforts to determine the proper division of the extra cost on the first road. How are we to determine just what the excess amounts to? Is it proper to charge all of the excess to the passenger service when the freight service is benefited as well? Modern signaling, as an example, is usually regarded as an essential to safe passenger train operation, yet the cost of these signals may be and usually is fully justified by the assistance which the signals afford to freight trains and the consequent increase in the capacity of the road to move more trains. It may be fairly alleged, however, that higher standards of maintenance, such as the use of crushed stone ballast, are due principally to the demands of the passenger service.

In testifying before the Interstate Commerce Commission in the Western Passenger Fares case in 1915, Mr. George R. Martin, then Comptroller and now Vice-

President of the Great Northern Railway, stated (pages 2315-16, stenographer's record):

Then if you are going to put on a fast, heavy passenger service, you would have to raise the standard of maintenance to another level, and the difference between this first level and the second level is entirely on account of passenger train service that is going over that line. On the main line, where the through, heavy passenger trains run, beyond a certain point or standard of maintenance there is an expense up to another standard which is entirely chargeable to passenger service, in my opinion. . . . [To raise the standard] ordinarily you would put in heavier rail, probably increase the number of ties to the rail, increase the quantity of ballast, and in connection with that, probably it would be necessary to widen the banks. The same thing, of course, applies to the bridges. . . .

There would be a greater lift of ballast and it would come out more as a shoulder beyond the ends of the ties. The re-working that you speak of, would, of course, be an improvement; that is, it would keep the track in better shape; the more labor you put on to keep up the roadbed and to keep the shoulders in place so the track will hold where it is, where it should be, of course, brings the track to a better standard than it would be if you did not re-work it.

The classification of the Interstate Commerce Commission ignores the factors of natural deterioration and standard of upkeep. As a rule, too, the railroad accounts and public accountants take no specific account of these influences on maintenance costs. In a few cases, such as the Buell case already mentioned,¹ a distinction is made between wear and tear and deterioration, and the two elements are recognized by different methods of apportionment.

¹ See reference to Buell case on p. 210. Similar distinction made in statistics presented in the Class Rate Advance case (I. C. C. Docket 3500). The Rock Island maintenance expenses were apportioned on three bases: (1) that used by the Rock Island in its own accounts; (2) that provided by the Nebraska formula; and (3) that provided by the Missouri formula. Under bases 1 and 3 the total maintenance of way expenses were apportioned on train miles, but under the Nebraska formula 10 per cent of such expenses were divided on train miles and 90 per cent on operating revenues.

In the Railway Mail Inquiry, 1912, the Post Office Department, in making its own separation of expenses from the figures presented by the railroad companies, divided certain maintenance expenses 10 per cent on train miles and 90 per cent on direct charges under maintenance of equipment and transportation.

IV

Among the various bases which have been used or suggested from time to time, the following may be mentioned:

- (1) Train miles.
- (2) Train miles and switch locomotive miles combined.
- (3) Train ton miles (gross ton miles).
- (4) Locomotive miles, road service only.
- (5) Locomotive miles, road and switching.
- (6) Locomotive ton miles.
- (7) Car miles.
- (8) Train miles and car miles combined.
- (9) Weighted train ton miles and locomotive miles combined.
- (10) Direct expenses.
- (11) Operating revenues.
- (12) Tons of fuel consumed by road and switch locomotives.

The train mile basis is the oldest and has been that most generally used. It was prescribed by the Interstate Commerce Commission in its first (1887) classification of expenses, and prior to then had been used by the Pennsylvania Railroad and other railroads in separating their expenses. It was understood, however, and the Pennsylvania Railroad has always been careful to make the qualification, that the results were worked out only for the purposes of administrative control of expenses, and were not in any sense to be considered "costs" from which any conclusions could properly be reached in considering rates.

When the train mile basis was first used by the Pennsylvania Railroad the differences between the average

freight train and the average passenger train were not so great as they are at the present time. Freight trains then were little longer or heavier than passenger trains. Approximately the same type of locomotive was used interchangeably in both classes of service. The train mile then was a fairly accurate unit for measuring joint costs. It was believed that the greater speed of the passenger train justified a charge equal to that levied against the heavier but slower moving freight train.

At the present time the average freight train consists of approximately thirty-six cars, loads and empties, which weigh approximately 1200 tons. The average passenger train has about six cars which weigh approximately 380 tons.¹ The weight of the average freight train, therefore, is more than three times the weight of the average passenger train, and the former has about six times the number of cars.

It is obvious that the use of the train mile basis charges the passenger service as much for six cars or 380 tons as it charges the freight service for thirty-six cars or 1200 tons. This charges too much to the passenger service, even when an allowance is made for its greater speed. The speed of the passenger train undoubtedly causes additional stress and shock, and adds to wear and tear, but it is too much to say that the speed factor equalizes the weight factor, or that the effect on maintenance costs by either train is about the same. If that were true, it would follow that the lighter passenger train causes three times as much damage *per ton of train*, or between four and five times as much *per wheel*.

The Wisconsin Commission, in considering the Buell case, asked Professor W. D. Pence, of the engineering department of the University of Wisconsin, for his

¹ This average is for all passenger trains — through, suburban and branch line. A modern through express train, consisting of eight steel cars, weighs about 550 tons.

opinion on the relative destructiveness of passenger and freight trains. His report, as summarized by the Commission, was:

The wear of the wheel tread is a good basis for estimating the wear of rails.

The wear of the drivers is more rapid on freight than on passenger locomotives.

The wear of drivers on passenger locomotives is not increased as speed increases.

Hammer blows of drivers is frequently more injurious to rails with freight service than with passenger.

Passenger rolling stock is less severe on the track and structures than freight cars.

Rail deflections and roadbed pressures do not increase directly as the speed.

Cost of raising and tamping track is not increased with increased proportion of passenger trains.

Tie renewals are chiefly due to decay.

Notwithstanding this definite expert testimony, there is force to the contention that the element of speed should have serious consideration, even tho with the average train at average speed this factor is not a controlling element in maintenance expenses. The design of the locomotive aims to compensate, in some measure, for the effect of speed. Passenger locomotive drivers are larger and are counterbalanced for speed.

The views in opposition to the testimony of Professor Pence were well expressed by Mr. George R. Martin in the Buell case. Mr. Martin, while then and now in charge of the accounting department of the Great Northern Railway, has had extensive railroad experience in the operating department, and at one time was general superintendent of the Montana Central Railway in charge of both operation (including maintenance) and construction. His views, as a broadly trained operating and accounting officer, are entitled to respect. In his testimony he stated (page 2313, stenographer's record):

The repairs of the track structure, of which you speak, are to my mind caused to a greater extent by the speed than by the weight; that is, the speed of the trains in passing over the track has a great deal of effect in the wearing out of the track, and that refers very particularly to the portions of the track where there are breaks in the running surface. Of course, that means every joint or every frog, or wherever there may be a break in the running surface. . . . The speed involves a blow at the joints and breaks them down, both as to the rails themselves and the rail fastenings and the support that is given by the ballast and the sub-grade.

The advocates of the train mile basis contend further that it is the locomotive which causes the greatest wear and tear to the track. This contention, too, has force. Engineering authorities support the general statement, but differ in their estimates of the weight to be given.¹

The subject has had the attention of the American Railway Engineering Association. In 1913 a committee of that association presented an elaborate report, which suggested a method for "weighting" locomotives and cars in the two classes of service according to their relative destructiveness on track and structures. The committee's recommendations stated in ratios, were that:

Ton miles in freight service should be considered as 100.

Ton miles in passenger service should be considered as 200.

Locomotive miles in freight service should be considered as 200.

Locomotive miles in passenger service should be considered as 400.

¹ "The locomotive alone causes by far the greater portion of this wear — how much is not positively known. Freycinet, a French engineer, writer, and politician of much prominence, recently Minister of Public Works, estimates that the locomotive does three-fourths of the damage and the train itself only one-fourth. Launhardt, a German writer on the subject, after noting the fact that the locomotive and tender together constitute only one-fifth of the total weight of train on the Prussian state railways (it would be considerably less in this country) considers that half the wear is due to the locomotive and tender and half to the train. This in all probability is a very moderate estimate." A. M. Wellington, *Economic Theory of Railway Location*, 6th ed., 1906, p. 122.

The association declined to commit itself to the formula. "There was vigorous opposition to these views, some engineers pointing out that although passenger traffic, as a rule, required more expensive road-bed and better up-keep, the freight trains were relatively as destructive of track, if not more so of track structure. The whole matter was, therefore, referred to the committee for further study, and no subsequent report has yet been made."¹

V

The gross ton mile basis (total weight of train — cars and contents — multiplied by the train mileage) is highly favorable to the passenger service. This method was advocated by representatives of certain state commissions, and is approved by some railroads which keep such statistics currently as a check on operating efficiency. The average passenger train has less than one-third the weight of the average freight train. Moreover, it takes no account whatever of speed, nor of the weight and greater destructiveness of the locomotive alone as compared to the wear and tear of the cars alone. It is hardly probable that the gross ton mile basis will ever be seriously considered as a basis for the apportionment of expenses, although it was suggested by the public accountants who testified for the protestants in the Western Passenger Fares case.

Even were the basis otherwise unobjectionable, its propriety may be questioned on technical grounds, inasmuch as it is practically impossible to ascertain the weight of the passenger train "load." No record is kept of the weight of passengers, baggage, mail, express,

¹ "Apportionment of Railroad Expenses and Property Values on Basis of Use," A. M. Sakolski, *Journal of Accountancy*, August, 1916.

or company supplies, transported in passenger trains. These must be estimated.

The road locomotive mile basis gives results substantially similar to those obtained by the train mile divisor, but it is slightly less unfavorable to the passenger service, since it takes account of helper and "double-header" locomotives which are used to a greater extent in freight service. Yet it has the defect of giving an equal charge to the passenger locomotive and the freight locomotive. It takes no account of the weight of the locomotive or its speed, and ignores (as do many other suggested bases) the effect of switching locomotives on yard tracks and on main tracks within yard limits.

To relieve the passenger service of the burden last referred to, another method has been used: road and switching locomotive miles combined. Since the greater part of switching locomotive miles are made in freight service, its inclusion tends to lighten the charge to passenger service. If the elements of weight and speed are to be left out of account, the road and switch locomotive mile basis is to be preferred to either the train mile, gross ton mile, or road locomotive mile basis.

The locomotive ton mile basis, defined by the Commission as "the product obtained by multiplying the number of tons (2000 lbs.) in weight of the locomotive ready for service (but exclusive of the tender when the tender is a separate car) into the number of locomotive miles made by it," is the basis which was suggested by many railroads in the hearings on the subject before the Interstate Commerce Commission prior to its promulgation (in 1914) of the existing rules. The theory is that the major part of the wear and tear is caused by the locomotive, and is in some degree proportional to

its weight. Freight locomotives as a rule are heavier than passenger locomotives, particularly the freight locomotive used to haul full tonnage trains in slow service. This feature automatically takes some account of the greater tonnage in long freight trains, but the difference in the weights of the two locomotives is relatively less than the difference in the weights of the trains. The locomotive ton mile basis to that extent, therefore, favors the freight service. Its advocates claim, however, that the apparent favoritism is fair because of the greater speed of passenger trains.

While it is true that the locomotive ton mile basis was proposed by railroad representatives in the hearings before the Commission, it has by no means unanimous railroad approval. The Committee on Corporate, Fiscal and General Accounts of the American Railway Accounting Officers, has gone on record, since the promulgation of the Commission's rules, as refusing to endorse the basis until more is known of the real relationship between weight of the locomotives and train speed.

The car mile basis has had but limited application. Obviously it is unfair to the freight service, as the average freight train has about six times as many cars as the average passenger train. The car mile basis ignores the differences in train speed and in the weight of the cars. It spreads the effect of the freight locomotive over thirty-six cars, while the effect of the passenger locomotive is distributed over but six cars.

The combination or average of train miles and car miles is occasionally used as a compromise. The train mile basis burdens the passenger service; the car mile basis burdens the freight service. The average of the two may equalize the advantages and disadvantages, but it must be regarded as an empirical makeshift.

The "weighted" train ton and locomotive mile basis is that referred to earlier in this article as the suggestion of the committee of the American Railway Engineering Association. So far as the writer knows this basis has not been tested in practice, and it failed, when presented, to receive the endorsement of the association.

The direct charges basis calls for the division of joint expenses in the maintenance of way group in the same proportion that the direct charges to freight and passenger bear to the total expenses directly allocated. Direct charges include such items as train wages, fuel, allocable station and yard expenses, and the cost of maintaining locomotives and cars. The use of this method is justified on the theory that joint costs which do not lend themselves to any method of exact apportionment should be divided between the two classes of service in the same proportion as the total of the costs which may be directly and accurately assigned. We *know* that it is fair to both classes of service to charge each with its directly allocable expenses; we may *assume* that it likewise is fair similarly to divide the joint expenses.

The same theory is applied to such expenses as are common to one group, in which the major part may be directly allocated. For example, the cost of superintendence under maintenance of equipment is divided in proportion to the direct charges for the maintenance of locomotives and cars. In such cases there can be no objection to the plan, and indeed no better has been suggested. But the propriety of applying the proportions of direct charges in the transportation group alone, or in the transportation and maintenance of equipment groups together, to the common expenses in the maintenance of way group, is questionable. The proportion of direct charges to the passenger service in transporta-

tion expenses is likely to be higher than its proportion in maintenance of equipment expenses, and the result of applying the direct charges method to common maintenance of way expenses depends largely upon whether the ratio is confined to transportation direct charges or to transportation and equipment direct charges combined. In the New England Milk case, to be referred to later in detail, the figures indicate that for the road in question, the Boston and Maine, the passenger proportion of direct transportation charges was 46.8 per cent, while the passenger proportion of equipment maintenance direct charges was 29.9 per cent. Combining the two groups of direct charges gave the passenger proportion as 39.6 per cent. As a coincidence merely, that percentage happens to agree closely with the results obtained under the train and car mile, the operating revenues, and the fuel consumption bases.

Operating revenue, as a basis for the division of joint maintenance of way expenses, has been used in isolated cases, and is occasionally suggested. Its only support is the theory of "ability to pay." Maintenance of way expenses, in the main, are joint costs which are not susceptible of any exact division according to use; therefore, according to this theory, they should be recorded as "overhead" expenses and distributed according to the earning power of the two classes of service. It is plain that this involves reasoning in a circle, and it has no justification in determining the reasonableness of rates under investigation. A reduction in the rates in either class of service would have the effect of reducing the apparent cost of that service.¹ If, for example, in a given case, where the total charges to

¹ "If the property is to be divided according to value of use, it is plain that the gross earnings method is not an accurate measure of value.

"The value of use, as measured by the return, cannot be made the criterion when the return is itself in question." Justice Hughes of the United States Supreme Court in the Minnesota Rate case.

each class of service were equal, the passenger rates were reduced without reducing or increasing the volume of passenger traffic, and caused a reduction of 10 per cent in passenger revenue, then the charge to the passenger service (or the apparent "cost") would be reduced 2.6 per cent and the charge to the freight service would be increased 2.6 per cent,¹ even tho the actual expenses in either class were not affected in any way.

In the Western Passenger Fares case the Interstate Commerce Commission, after considering the several methods advocated by the accountants of the carriers and the protestants for dividing maintenance of way expenses, rejected all of them (including locomotive ton miles, gross ton miles, revenue train miles and direct charges in train service and equipment maintenance) and used a direct costs basis of its own, which embraced only seven accounts, viz.:

Road enginemen.

Fuel for road locomotives.

Water for road locomotives.

Lubricants for road locomotives.

Other supplies — road locomotives.

Road trainmen.

Train supplies and expenses.

The Commission accepted the railroads' allocation or apportionment for all expenses except those under maintenance of way, which the Commission divided on the direct costs method just described. In doing so the Commission stated:

Our decision to use this method in this case must not be regarded as conclusive on our part of the method that should ultimately be used for the division of the maintenance of way and structures

¹ <i>Before reduction in rates</i>			<i>After reduction in rates</i>
Passenger revenue	100 or	50%	90 or 47.4%
Freight revenue	100 or	50%	100 or 52.6%
Total revenue	200 or	100%	190 or 100%

expenses between passenger and freight. The objections against the direct charge method are known and appreciated. If, for example, a marked increase in wages of enginemen on passenger trains takes place, the result under this method is to increase the amount of unallocated expenses assignable to passenger business, while the actual utilizations of the track and structures by the two branches of the service remain unchanged. We are using these direct costs in this instance to determine the apportionment of unallocated expenses between passenger and freight because the objections to this method seem less forceful than those that have been urged against any of the other methods proposed.¹

The Commission's decision to use this selected direct charges method in that case is interesting, as it is of comparatively recent date (decided December 7, 1915) and, notwithstanding the statement that it "must not be regarded as conclusive" it may give some indication of the trend of thought in the minds of the commissioners and their statisticians.

VI

In the New England Milk case (40 I. C. C. 699, decided July 11, 1916) the writer was engaged by the Boston and Maine Railroad to prepare its statistics pertaining to the milk revenue and the proportion of expenses which properly should be apportioned to the milk service. The Boston and Maine handles milk both on passenger trains and freight trains. It was necessary, therefore, first to divide expenses between passenger and freight, and then to apportion the charges in each class of service to the milk traffic in that service.

In the study of the problem it occurred to the writer that the tons of fuel consumed by road and switch locomotives should furnish the least objectionable and the most defensible basis for apportioning the joint expenses under maintenance of way. The decision in the Western Passenger Fares case was published when

¹ 37 I. C. C. 23.

the figures were being compiled, and it seemed to the writer that if the Commission could tentatively approve a direct charges method which essentially included only fuel and wages of train and engine crews (since water, lubrication, and other supplies are usually divided arbitrarily on fuel issues, locomotive miles, or locomotive ton miles) they could also approve the basis of fuel issues alone. The tonnage of fuel consumed is unaffected by variations such as those mentioned by the Commission.

Before discussing the fuel basis, it may be stated at this point that while the Commission conceded what the Boston and Maine statistics purported to show, that is, that the milk traffic, under the rates then in effect, was not assuming its fair share of expenses, yet it did not approve the fuel basis as a divisor for maintenance of way expenses. Nor did the Commission suggest an alternative method.

So far as the writer has knowledge, fuel consumption as a basis for dividing maintenance of way expenses has been used only in the case just referred to. It is prescribed by the Commission as the divisor for the cost of maintaining water stations and for the division of the cost of water used by locomotives. The protestants in the New England Milk case, therefore, were justified in characterizing the fuel method as "novel and untried."

The theory upon which the fuel basis is offered as a substitute for train, locomotive and car miles or combinations thereof, is that it is a more scientific measure of use. Fuel consumption, in a large degree, is proportional to the horsepower developed. Horsepower is the resultant of locomotive tractive force and speed.¹ A

¹ The formula is:

$$\text{Cylinder horsepower} = \frac{(\text{Tractive force in lbs.}) (\text{Speed in miles per hr.})}{375}$$

given number of horsepower may be utilized in hauling a heavy train at slow speed or a light train at high speed. Speaking in general terms, in locomotives of similar design, the horsepower developed is closely related to the volume of steam used in the cylinders, and the steam production in boilers of similar design is in turn closely related to the amount of fuel consumed in the firebox. There is, however, a critical point in the piston speed at which the horsepower efficiency is greatest.

Since the horsepower developed is directly proportional to the speed of the train, it follows that the fuel consumption by a given train increases somewhat in proportion to the speed of the train. Fuel consumption, however, does not vary directly with speed, yet it bears a close relation to it. It is impracticable to show the relation exactly by formula, because of the many variable factors which affect train resistance and locomotive boiler and cylinder efficiency; but the indications of many tests support the statement that as between trains of different classes on the same division, the fuel consumption, as a measure of train horsepower, automatically equates for both weight and speed. It takes account of the weight or power of the locomotive, the weight or number of cars, and the speed of the train. It affords, then, the only least common multiple yet suggested that has some claim to the term scientific.

From an accounting viewpoint the fuel basis is desirable as it requires no special compilations when (as should be done for other purposes) fuel consumption statistics are kept separate for the three classes of service — freight, passenger, and switch. The use of the locomotive ton mile basis, on the other hand, requires the keeping of special statistics for that purpose alone, and, moreover, the basis is less scientific.

The range of difference in the results obtained by using several of the bases which have been discussed, may be seen if they are applied to the maintenance of way and structures expenses of the Boston and Maine Railroad (using the figures contained in the evidence presented in the New England Milk case). The total charges to that group of expenses during the year ended June 30, 1915, were \$7,118,602. A small part of these expenses were allocated directly, but for the purpose of illustration we will apply the several methods to the total of the entire group of maintenance of way and structures. They are arranged in the order in which they burden the charge to passenger service.

Basis	Chargeable to Passenger Service	
	Per cent	Amount
Revenue train miles	60.7%	\$4,320,991
Revenue road locomotive miles	57.1	4,064,722
Revenue road locomotive ton miles	53.0	3,772,859
Direct charges; transportation costs only ..	46.8	3,331,506
Revenue train miles and car miles	40.6	2,890,152
Fuel consumption; road and switch locomotives	40.0	2,847,441
Direct charges; transportation and equipment	39.6	2,818,966
Operating revenues	39.3	2,797,611
Gross revenue train ton miles (estimated) ..	33.3	2,370,494
Revenue car miles	20.6	1,466,432

The difference between the charge to passenger service on the train mile basis, \$4,320,991, and the charge on the car mile basis, \$1,466,432, is nearly three million dollars. It will be noted that there is little difference in the results under four of the bases, viz., train miles and car miles combined, direct charges under transportation and equipment maintenance, fuel consumption, and operating revenues. The Boston and Maine exhibits in the milk case were computed under the fuel consumption basis.

If the perplexing difficulties surrounding the apportionment of maintenance of way expenses can be satisfactorily overcome, the problems connected with the division of other operating expenses are comparatively easy. The rules of the Commission applying to maintenance of equipment, traffic, transportation and general, are sound and workable. They have been described earlier in this article.

As stated in the beginning, the scope of this article is purposely confined to the one subject of separation of operating expenses between the freight and passenger services, and to suggest the fuel basis as the least indefensible divisor for joint maintenance of way expenses. To pursue the subject further would require an extended discussion of two general problems closely allied to the freight-passenger apportionment, viz., the separation of expenses by states, and their separation between terminal and line. Or we might go further and undertake a discussion of "splitting the homogeneous fibres of a single cost jointly caused" in attempting to ascertain the "cost" of hauling a particular commodity.

These problems are now under discussion in an important rate case in Central Freight Association territory. The railroads in interest are attempting to work out an assignment of expenses:¹

- (1) To States.
- (2) Between line (or hauling expense) and terminal (or station expense).
- (3) Line and terminal between freight and passenger.
- (4) Freight — line and terminal — between state and interstate.
- (5) Passenger — line and terminal — between state, interstate, and mail and express.

¹ This assignment follows closely the Oklahoma formula which is well described by Hooper (Railroad Accounting, chap. 15).

The railroads in eastern territory are now engaged in a study the results of which may throw some light on the moot point of the proper spread between the rates on car-load and on less-than-car-load shipments of the same commodity.

The railroads of the entire country are confronted with the necessity for preparing figures which will show the relation between the cost of carrying the mail and the revenue under the new car-space basis.

These cases give some idea of the far-reaching importance of the apportionment of operating expenses. The primary separation between passenger and freight is only one step in the process. Each additional step presents its new problems. It is desirable, therefore that the Commissions, both State and Interstate, and the railroad accounting officers, should make a serious effort to harmonize conflicting ideas and practices, and to agree upon some definite and comprehensive plan of expenses apportionment.

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